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GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

Notes upon Warping of the Earth's Crust in its Relation to the Origin of the Basins of the Great Lakes.—Evidence of unequal oscillation of continental areas, producing warping of the crust of the earth in the valley of the Mississippi and in the basins of the Great Lakes, is of importance. Numerous borings have been made by the Mississippi River Commission—along the course of the Mississippi River, and on its flood-plains between Lake Providence, La., and New Madrid, Mo.—that have passed through the alluvium and entered the Lignitic clays, which Mr. Wilson (of the Commission) identified as those of the Lignitic (Eocene) group of Professor Hilgard.

From measurements of these borings, given in the Report of the Commission for 1881, I have found that the slope of the bed of the preglacial valley, for a distance of three hundred miles below New Madrid, is only 0.41 foot per mile, while that of the modern surface throughout the same region is 0.62 foot. Between Lake Providence and the Gulf the slope of the surface is only

0.35 foot per mile, while that of the ancient bed is indefinitely greater, as shown from the record of the borings of the deep well at New Orleans. From New Madrid to St. Louis the slope of the valley is 0.73 foot per mile, but above it is reduced to about half a foot, throughout a long stretch below Rock Island Rapids. Above the Rapids (where the fall is twenty-two feet in fourteen miles), for two hundred miles the slope, so much nearer its higher waters, is again reduced to only 0.28 foot per mile.

The valley at St. Louis is about eight miles wide. Within a mile of its western side, as shown at the eastern abutment of the St. Louis bridge, the old channel reaches to a depth below the flood-plain of one hundred and thirty-six feet, increasing towards the eastward. Therefore there is every reason to conclude that from New Madrid to St. Louis, or even above it, the floor of the buried valley slopes less than that of modern days, although the borings upon its margin are not so deep as those at New Madrid, which are several miles away from the edges of the flood-plains.

Above St. Louis, the valley, with a breadth of several miles, narrows more or less gradually, except at two places, as we ascend it for eight hundred miles. At these two places the contraction is sudden, and only adjacent to them does the river flow over hard rock. The lower of these two exceptions is along the Des Moines Rapids, at Keokuk, adjacent to which General G. K. Warren discovered a buried channel through which the river once flowed. The other locality where the valley is narrow is below Rock Island. Above here the valley of the Mississippi broadens out and joins the valley of Rock River of Illinois. Along the Rapids, which are on the western side of Rock Island, the river passes over a limestone-bed, which dips at a low angle down its course. From this point to the mouth of the Mississippi the size of the valley is more or less in conformity with the erosive power of a constantly-increasing body of water. But from Rock Island down to Muscatine the river flows through a comparatively narrow cañon, which is quite out of keeping with the size of the valley above and below this section, showing an origin under different physical conditions. At Muscatine it suddenly widens out to eight miles. General G. K. Warren and other gentlemen, besides the writer, have endeavored to find an adjacent buried channel of commensurate importance with the size of that above and below this region, but without success.

Northward of St. Louis the floor of the buried valley rises. It is not known whether the modern channel of the Des Moines Rapids at Keokuk has been produced by erosion into the rocky floor, exposed by the upward warping of the earth's crust, or by the river deflected over hard rock by the filling up of Warren's channel to the westward.

As has been stated, the slope of the valley above Rock Island Rapids is only half that below. But a more striking difference exists along this floor of the buried channel, as shown by various borings at Prairie du Chien, La Crosse, and elsewhere, from which we learn that the bottom does not slope southward, but actually to the northward. Even at La Crosse, two hundred miles north of Rock Island Rapids, the bed of the old channel is fifty feet below that at the Rapids.

From the above observations it is apparent that there is a transverse warping across the Mississippi, which has culminated at Rock Island, and exposed a floor of the hard rocks to be eroded during later geological days. The uplift is further demonstrated by the observations of Mr. W. J. McGee, who finds that an old channel of the Mississippi leaves the mouth of the Maquoketa River, and is coincident with it for several miles, and then passes southward to the valley of the Wapsipenicon, with which it is identical to its mouth. This old valley is from one to three miles wide, and rises to fifty feet above the Mississippi River. It is cut not only through the Palæozoic rocks, but also through the Drift and Loess. The floor consists of alluvium only. Accordingly, the uplift or warping has been quite recent. As this channel is above Rock Island, its presence does not relieve the necessity for an explanation of the stricture in the valley below that place, but only shows more plainly the warping of the strata in later geological times, which has brought up the old rocky floor of the region to be chiselled into by the waters flowing since the Drift epoch.

This warping is part of a fold which extends across the continent to the Great Lakes, and has a bearing upon the production and separation of their basins. A low anticlinal extends from the head of Lake Ontario westward, between Lake Huron and Lake Erie, and beyond, as was long ago pointed out by the geological survey of Canada. It is along the axis of this fold that the Dundas valley—part of the ancient outlet of the Erie basin—is located, where the dip of the strata upon the southern side is twenty-five to thirty-seven feet per mile to west of south, and eighty feet and upward upon the northern side in the opposite direction. In the peninsula (thus rendered somewhat weak) between the Lakes Ontario and Erie local warpings are visible in many places. Furthermore, Mr. G. K. Gilbert has observed that the old shore-lines about Lake Erie rise to the eastward and northward, thus showing that the basins across the old outlet have been recently raised.

The same gentleman has also observed that a conspicuous terrace south of Lake Ontario rises one hundred and thirty feet in proceeding from the western end of the lake to Oneida Lake, south of its eastern end. From this region northward to Adams Creek, Jefferson County, the terrace rises one hundred and seventy feet more; but north of this it has not been seen (*Science*, September 11, 1885). Further evidence of warping along a line probably reaching northward as far as the eastern end of the lake has been gathered by Mr. W. J. McGee, who finds a recent uplift of twenty-five feet in Virginia to four hundred to five hundred at New York, which has not been followed farther northward.

The Palæozoic strata at the eastern end of Lake Ontario has a much greater dip than at the western end; for near the outlet the Trenton limestones dip from fifty-three feet in a mile to three or four degrees, and in direction eastward of south. A depression of only ten or twelve feet from the outlet of the lake southward, during a period of high continental elevation, when the valley of Lake Ontario was formed (and we know from the soundings in the St. Lawrence, farther down, that the elevation reached to twelve hundred feet at least), would be sufficient to make the broad plain adjacent to the St. Lawrence a continuation of the valley of Ontario, and drain all of its waters.

The time of general warping doubtless took place during the periods of oscillation between that of high continental elevation before the Ice Age, and the subsequent submergence in the later Pleistocene epoch to perhaps seventeen hundred feet, in Ontario and Michigan, below the present level (some of the present terraces north of Lake Ontario are certainly marine), and that of the adjustment to the present relative elevation of land and sea, which, to a considerable extent, has been since the Terrace epoch.—*J. W. Spencer, Ph.D., F.G.S., University of Missouri,* January, 1887.

The Formations of the Belly River of Canada.—In his report on the geological survey of the Dominion, Mr. George M. Dawson describes a new formation, to which he gives the name of the Belly River epoch.

The deposit is immediately overlaid by the Pierre or number four cretaceous of Meek and Hayden, which in turn is overlaid by the Laramie. The Belly River beds are of lacustrine origin. It is well known that the Pierre beds are of marine origin, while the Laramie beds are lacustrine. The Pierre fauna of the Dominion is identical with that already known, while the Belly River beds also contain numerous fossil remains. The plants have been studied by Sir William Dawson, who finds them to be identical with those of the Laramie. The same conclusions have been reached by Mr. Whiteaves as to the Mollusca, and Professor Cope finds the vertebrates, of which there are numerous species, to be identical with those of the Laramie. It is difficult to believe that the same land fauna continued during two geological epochs so generally different as those of the Pierre and those of the Laramie. It is also difficult to believe that a deep-sea marine fauna could have occupied the interior of the continent during the stage of elevation presented by the Laramie. It is therefore suspected that there has been some error of observation. It must be said, however, that the conclusions of Mr. Dawson have been confirmed by two other competent members of the survey.—*E. D. Cope.*

The Cross-Timbers of Texas.—The paper recently read before the Washington Philosophical Society on "The Cross-Timbers of Texas," by Mr. Robert T. Hill, who is a native of that State, and now connected with the United States Geological Survey, gives some interesting data about that hitherto little studied region. The article demonstrated that these two belts of anomalous timber, instead of representing quaternary or tertiary basins, are merely the detritus of outcrops of arenaceous strata, those of the eastern member being probably of the age of Dakota sandstone, and the western of a sandy group at the base of the entire cretaceous series, part of which are of undetermined Mesozoic, and are given the name of "Dinosaur Sands" by Mr. Hill, while part of them are of undoubted Carboniferous age. He furthermore shows that the topography of the entire central region is the result of extensive denudation, whereby the members of the geologic series, from the marine tertiary to the Carboniferous coal-measures, are successively exposed along the line of the Texas Pacific Railroad, from Elmo to Millsap. The most interesting feature of Mr. Hill's paper, however, is that he demonstrates the existence of a marine group of the Cretaceous in Texas lower than any heretofore recognized in America, and completely clears up, by methods of stratagraphic palæontology, the vagueness that has hitherto accompanied our knowledge of that region. The palæontological results of the work are also very interesting, and will be studied and presented by Dr. C. A. White.

MINERALOGY AND PETROGRAPHY.[1]

Rosenbusch's "Massige Gesteine."—It is rarely that the revision of a standard work in any branch of science is followed with so much interest as has been the case with Professor Rosenbusch's "Mikroskopische Physiographie der Mineralien und Gesteine," the first part of the second volume[2] of which has recently been issued. When the first edition of this classical work appeared (1877) the study of rocks by means of the microscope had but just begun to take its place as an independent science, requiring new methods of investigation, new apparatus for these investigations, and new modes of reasoning by which the truths revealed by them could be made use of in the elucidation of many obscure problems in the broader science of geology. It is not surprising, then, that as petrography increased its store of

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[1] Edited by Dr. W. S. BAYLEY, Madison, Wisconsin.

[2] Massige Gesteine, I. Abt., Stuttgart, 1886. E. Schweizer bart'sche Verlagshandlung (E. Koch).